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INVESTIGATION OF GROUND-WATER CONDITIONS AT THE W.G. KRUMMRICH PLANT MONSANTO COMPANY SAUGET, ILLINOIS

THIRD QUARTERLY REPORT

September 1984

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INVESTIGATION OF GROUND-WATER CONDITIONS
AT THE W.G. KRUMMRICH PLANT
MONSANTO COMPANY
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INTRODUCTION

The findings of the third round of the ground-water sampling program are presented in this report. The purpose of this portion of the study is to determine whether changes in either ground-water flow patterns or ground-water quality have occurred in the six-month period following the collection of samples in November 1983 and February 1984 (see First and Second Quarterly Reports).

Static water-level measurements were made in May, June, and July 1984, and these data are provided in Table 1. Figures 1, 2, and 3 show the configuration of the water table and ground-water flow directions for each round of measurements. Hydrographs for Wells 1, 2, and 3 and the Mississippi River are shown in Figures 4a, 4b, and 4c and provide a continuous record since November 1983. These figures also contain precipitation data for the Lambert - St. Louis International Airport.

Ground-water samples were collected from all 12 monitoring wells during May 7-10, 1984, and a summary of the parameters that were examined are given in Table 2. The analytical data for the May sampling period is summarized and presented in Tables 3 and 4, with February's data (Table 5)

and November's Results (Tables 6 and 7) included for comparison. The distribution of various constituents in the ground water are presented in Figures 5 through 9.

GROUND-WATER MOVEMENT

The water-table configuration in the study area is shown on Figures 1, 2, and 3, with water-level data given in Table 1. These figures illustrate that the direction of lateral flow and the shape of ground-water mound beneath the plant process area that were depicted in the first and second quarterly reports are either absent or masked by a high water table. Water levels have remained relatively constant for the May through July 1984 monitoring periods with a range in elevation of only 1 to 2 feet among the 12 wells.

Figure 1 illustrates a fairly flat water table with ground-water movement towards the south for the first time since the monitoring program began. This change in flow direction may be due to Cerro Copper's fire protection well (No. 6) which operates continuously at 100-200 gallons per minute (gpm) and possibly their well for process water (No. 5) which pumps 150 gpm on selected days of the month. If one or both these wells were operating when water levels were measured, given a relatively flat water table, the flow directions illustrated in Figure 1 are possible. However, Midwest Rubber has three wells (about 110 feet deep) which pump approximately 500,000 gallons per day (gpd) or 347 gpm. This volume of pumpage may be enough to direct ground-water flow to the south.

It is also possible that the higher river stage (408.98 feet above mean sea level) on May 8, 1984 has actually reversed ground-water flow in the ground-water system. The river stage elevation (U.S. Corps of Engineers depot) is more than 5 feet higher than the water-level elevation in Well 3.

Figure 2 demonstates a change in ground-water flow along the west side of the plant property. It appears that the cause of ground-water movement to the south (Figure 1) has ceased or has been masked by larger ground-water withdrawals, at least for the time period when water levels were determined. The Clayton Chemical well (16 gpm) and the Trade Waste Incineration well (30 gpm) do not pump at a rate sufficient enough to alter ground-water flow directions to the magnitude that is illustrated in Figure 2. Therefore, it appears likely that either one or both of these wells were pumping at significanly larger rates during the time that Monsanto's monitoring wells were measured, or one or more dewatering wells were pumping in connection with construction operations. In either case, the pumping rates must be greater than Cerro Copper's well 6 (100-200 gpm on a continual basis) in order to divert ground-water flow away from Cerro Copper's facilities, provided that Cerro's well(s) are in operation.

In Figure 3 a ground-water contour spacing of one-half foot was required to illustrate flow patterns because the water table is very flat. Ground-water movement across the eastern half of Monsanto's property is towards the Mississippi River, however, in the vicinity of Cerro Copper it appears that some movement is being induced to flow toward Cerro or Midwest Rubber. It is evident that conditions causing ground-water flow toward the Sauget Treatment Plant in Figure 2 have changed at the time represented.

Figures 1, 2 and 3 demonstrate that the seasonal high water table is very flat. As a result, low pumping rates can impact the direction of ground-water flow at this time of year. This is significant because moni-

toring wells that were installed downgradient of known or suspected sources of contamination during the seasonal low water table may not always represent the downgradient direction. Coversely, upgradient well locations may not always reflect upgradient water quality conditions.

Changes in ground-water levels with time are shown in Figures 4a, 4b, and 4c which also contain hydrographs for the Mississippi River at U.S. Army Corps of Engineers Depot in Missouri, about 1/2 mile downriver, and precipitation data for Lambert-St. Louis International Airport. Water-levels continued to increase in all three wells through April 1984, as a result of precipitation and a unusually high water level for the Mississippi River. The hydrographs for each of the three wells illustrate a flattening of the water table for the months of May, June and early July 1984, as the dryer season approaches.

GROUND-WATER QUALITY

The water samples collected from all 12 monitoring wells were analyzed by Envirodyne Engineers, Inc. St. Louis, Missouri, for the U.S. Environmental Protection Agency's (USEPA) list of priority pollutant parameters, total organic carbon (TOC), total organic halogen (TOX), total phenols, and chloride (Table 2). In addition, a field blank, a trip blank, and a laboratory blank were also analyzed for the same parameters. The analytical results are provided in Tables 3 and 4 along with pH, temperature, and specific conductance, which were measured in the field. The organic analyses were performed using gas chromatography/mass spectrometry (GC/MS). The analytical results for both the first and second quarters are presented in Tables 5, 6 and 7 for comparison. The analytical procedures used by Envirodyne Engineers were included in the first quarterly report. The distributions of specific conductance, total organic carbon (TOC), total organic halogenated compounds (TOX), total phenols, and total organic priority pollutant compounds in ground water, are provided in Figures 5 through 9.

Ground-water sampling procedures that were used during the initial program were duplicated for the third quarterly program in all aspects. Blind replicate samples were collected for Wells 3 and 12 and were analyzed for the same parameters as each of the other monitoring wells. Except for benzene in Well 12, the range of replicate results is very good.

Inorganic Constituents and Other Parameters

All parameters examined are relatively consistent with those observed

from the February 1984 sampling period (Table 3, 5 and 6), with a few exceptions. The range of replicate results for Wells 3 and 12 is very good.

Conductivity continued to decline at well 3 (4,000 to 3,500 umhos/cm) and at Well 12 (7,000 to 5,500 umhos/cm), and rose significantly only at Well 6 (1,900 to 2,600 umhos/cm). Total phenols remained relatively constant for most wells as did total organic carbon (TOC). Total organic halogens (TOX) increased at Well 6 (31 to 190 ug/L) and Well 9 (59/55 to 360 ug/L); however, the concentration at Well 9 was not nearly as high at the November analysis (750 ug/L). Chloride increased significantly only at Well 8 (10 to 150 mg/L) and decreased markedly at Well 2 (275 to 169 mg/L) and Well 9 (495/480 to 350 mg/L). Chloride values continued to drop at Well 12 (1,055/1,050 to 835/902 mg/L) and this reduction is most likely the reason for lower specific conductance values at Well 12, as well as at Wells 2 and 9. The continual decrease of both specific conductance and chloride at Well 12 may be in part due to the removal of the temporary salt pile that was located nearby. The chemical results for metals are all below detection limits and they are within federal limits, where they apply.

Overall, the quality of the data for the inorganic and selected constituents in Table 3 is about the same as was determined in the second quarterly report, which confirms the improvement in water quality we observed in the February 1984 results.

Priority Pollutant Organic Compounds

The results for the organic priority pollutant compounds (not analyzed in the second quarterly report) have not changed significantly since their initial analysis for the November 1983 sampling program. Methylene chloride was detected in all 12 well samples, both laboratory blanks and the trip blank, which, as discussed in the second quarterly report, indicates that its presence is probably a laboratory artifact (Table 4). Although, laboratory personnel use methylene chloride to clean glassware prior to a deionized water rinse and baking procedure, they apparently cannot remove it entirely from the glassware. It is also used as an extracting solvent in their laboratory and may cross contaminate from the air. Therefore, its reported presence in well water must be considered suspect, according to Envirodyne personnel.

The distribution of organic compounds, illustrated in Figure 9, shows the total priority pollutant compounds detected at each monitoring well (ug/L) with and without methylene chloride included in the total. By examining the distribution of the constituents it is readily apparent that only Wells 9 and 12 are contaminated with organic compounds. This same conclusion was also presented in the first quarterly report based on the initial sampling results for priority pollutant compounds (Table 7). In addition, specific conductance continues to have its highest values at Wells 9 and 12 and may be useful as an indicator for screening wells for organic contamination.

Blind replicate samples were collected for Wells 3 and 12 and were analyzed for the same parameters as each of the other monitoring wells. Except for benzene in Well 12 (3,263 vs. 4,819), the range of replicate results, especially at low levels is very good. The result for bis (2-ethylhexyl) phthalate at Well 12 (211 ug/L) was not supported by a replicate result of 2 ug/L. Envirodyne personnel believe that all bis(2-ethylhexyl) phthalate and butyl benzyl phthalate results are due to laboratory contamination of the water samples. Therefore, the only representative analyses for organic priority pollutant compounds found in excess of 100 ug/L are benzene (Wells 9 and 12), chlorobenzene (Wells 9 and 12), and 1,2-dichlorobenzene (Well 12).

Respectfully submitted,

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September 4, 1984

Appendix A

Tables

Table 1. Static Water levels for Shallow Water-Table Monitoring Wells, Monsanto Company, W.G. Krummrich Plant, Sauget, Illinois.

Well No.	May 8, 1984 Elevation of Measuring Point (feet above mean sea level)	May 8, 1984 Depth to Water (feet below measuring point)	May 8, 1984 Elevation of Water Level (feet above mean sea level)	June 7, 1984 Depth to Water (feet below measuring point)	June 7, 1984 Elevation of Water Level (feet above mean sea level)	July 10, 1984 Depth to Water (feet below measuring point)	July 10, 1984 Elevation of Water Level (feet above mean sea level)
1	413.65[a]	10.01	403.64	9.89	403.76	10.59	403.06
2	417.37	15.46	401.91	15.18	402.19	15.17	402.20
3	410.14 (411.35)[b]	7.49	403.86	9.40	401.95	8.92	402.43
4	406.43	4.21	402.22	4.76	401.67	4.34	402.09
5	414.94	12.58	402.36	13.17	401.77	12.68	402.26
6	414.59	12.42	402.17	12.48	402.11	12.32	402.27
7	414.95	12.49	402.46	12.85	402.10	12.35	402.60
8	418.49	16.53	401.96	16.47	402.02	16.24	402.25
9	414.47	12.22	402.25	12.02	402.45	12.24	402.23
10	412.97	9.79	403.18	9.82	403.15	10.14	402.83
11	412.95	9.90	403.05	9.76	403.19	10.14	402.81
12	416.47	13.29	403.18	13.22	403.25	13.66	402.81
U.S. Engineers Depot River Gauge	379.58	29.4[c]	408.98	21.8[c]	401.38	-[c]	-

a) All elevations are referenced to Bench Mark No. 15 (96.06 feet) at the southeast corner of Third and I Streets and have been converted to the NGVD datum. The elevations were determined to the top of the steel well casings for the 2-inch wells and to the top of the recorder shelter base for the 6-inch wells. The conversions to the W.G. Krummrich datum is 413.50 feet (NGVD) equals 101.00 feet (W.G. Krummrich datum).

b) The elevation of the measuring point was increased to accommodate a new recorder shelter.

c) Measurement is in feet above the measuring point.

Table 2. Summary of the U.S. Environmental Protection Agency's List of Priority Pollutant Parameters and Other Selected Constituents Analyzed by Envirodyne Engineers for Each Ground-Water Sample.

PRIORITY POLLUTANTS

Volatile Organic Compounds

- acrolein
- acrylonitrile
- benzene
- bis(chloromethyl)ether
- bromoform
- carbon tetrachloride
- chlorobenzene
- chlorodibromomethane
- chloroethane
- 2-chloroethylvinyl ether
- chloroform
- dichlorobromomethane
- dichlorodifluoromethane
- 1,1-dichloroethane
- 1,2-dichloroethane
- 1,1-dichloroethylene
- 1,2-dichloropropane
- 1,3-dichloropropylene
- ethylbenzene
- methyl bromide
- methyl chloride
- methylene chloride
- 1,1,2,2-tetrachloroethane
- tetrachloroethylene
- toluene
- 1,2-trans-dichloroethylene
- 1,1,1-trichloroethane
- 1,1,2-trichloroethane
- trichloroethylene
- trichlorofluoromethane
- vinyl chloride

Acid Extractable Organic Compounds

- 2-chlorophenol
- 2,4-dichlorophenol
- 2,4-dimethylphenol
- 4,6-dinitro-o-cresol
- 2,4-dinitrophenol
- 2-ntirophenol
- 4-nitrophenol
- p-chloro-m-cresol
- pentachlorophenol
- phenol
- 2,4,6-trichlorophenol

Base/Neutral Extractable Organic Compounds

- acenaphthene
- acenaphthylene
- anthracene
- benzidine
- benzo(a)anthracene
- benzo(a)pyrene
- 3,4-benzofluoranthene
- benzo(ghi)perylene
- benzo(k)fluoranthene
- bis(2-chloroethoxy)methane
- bis(2-chloroethyl) ether
- bis(2-chloroisopropyl)ether
- bis(2-ethylhexy)phthalate
- diethyl phthalate
- dimethyl phthalate
- di-n-butyl phthalate
- 2,4-dinitrotoluene
- 2,6-dinitrotoluene
- di-n-octyl phthalate
- 1,2-diphenylhydrazine (as azobenzene)
- fluoranthene
- fluorene
- hexachlorobenzene
- hexachlorobutadiene
- hexachlorocyclopentadiene
- hexachloroethane

Table 2. (Continued)

Base/Neutral Extractable Organic Compounds (cont'd.)

4-bromophenyl phenyl ether	indeno(1,2,3-cd)pyrene
butyl benzyl phthalate	isophorone
2-chloronaphthalene	naphthalene
4-chlorophenyl phenyl ether	nitrobenzene
chrysene	N-nitrosodimethylamine
dibenzo(a,h)anthracene	N-nitrosodi-n-propylamine
1,2-dichlorobenzene	N-nitrosodiphenylamine
1,3-dichlorobenzene	phenanthrene
1,4-dichlorobenzene	pyrene
3,3'-dichlorobenzidine	1,2,3-trichlorobenzene

Pesticides

aldrin	deildrin
alpha-BHC	alpha-endosulfan
beta-BHC	beta-endosulfan
gamma-BHC	endosulfan sulfate
delta-BHC	endrin
chlordane	endrin aldehyde
4,4'-DDT	heptachlor
4,4'-DDE	heptachlor epoxide
4,4'-DDD	toxaphene

Metals

antimony	mercury
arsenic	nickel
beryllium	selenium
cadmium	silver
chromium	thallium
lead	zinc

Miscellaneous

Cyanide

OTHER

pH	TOC
specific conductance	TOX
temperature	Cyanide
total phenols	

Table 3. Summary of Analytical Results (Inorganic Parameters and TOX, TOC, and Total Phenols) for Ground-Water Samples Collected During May 7-10, 1984 from Monitoring Wells, Monsanto Company, W.G. Krummrich Plant, Sauget, Illinois (concentrations are in mg/L, except where noted).

Parameter	USEPA Limits[a]	Well 1	Well 2	Well 3	Rep[b] Well 3	Well 4	Well 5	Well 6
pH (units)	-	7.6	7.3	7.9	7.9	7.1	7.2	7.3
Specific Conductance (umhos/cm)	-	1,000	2.600	900	900	1,050	700	2,600
Temperature (°C)	-	14	15	14	14	14	14	14
Total Phenols	-	0.014	<0.002	0.002	0.002	0.003	0.004	0.009
TOC	-	18	8	6	<5	6	<5	11
TOX (ug/L)	-	14	27	5	10	7	22	190
Cyanide	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chloride	250	48.5	169	11	12	76	12	117
Antimony	-	<0.05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Arsenic	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Beryllium	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium	0.01	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Chromium	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Lead	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Mercury	0.002	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Nickel	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Selenium	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Thallium	-	<0.2	<0.2	<0.2	<0.02	<0.2	<0.2	<0.2
Zinc	5.0	0.07	0.52	1.09	1.11	0.03	0.03	0.05

Notes: a) USFPA Drinking Water Standards. All limits are Primary Interim Drinking Water Standards, except the standards for zinc and chloride which are Secondary Drinking Water Standards.
b) Replicate samples for Wells 3 and 12 were collected in the field.

Table 3. (Continued)

Parameter	USEPA Limits[a]	Well 7	Well 8	Well 9	Well 10	Well 11	Well 12	Rep[b] Well 12	Field Blank	Trip Blank
pH (units)	-	7.1	6.8	7.3	7.3	7.3	7.8	7.8	7.0	-[c]
Specific Conductance (umhos/cm)	-	1,300	1,500	3,500	1,700	1,150	5,500	5,500	60	-
Temperature (°C)	-	14	14	16	15	14	16	16	17	-
Total Phenols	-	0.003	0.003	0.003	0.002	<0.002	0.86	0.054	<0.002	0.006
TOC	-	5	16	27	10	10	25	22	6	<5
TOX (ug/L)	-	18	82	360	14	15	4,700	5,500	-[d]	25
Cyanide	-	<0.005	0.099	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
Chloride	250	15	150	350	36	22	835	902	-	-
Antimony	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
Arsenic	0.05	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
Beryllium	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
Cadmium	0.01	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	-	-
Chromium	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-
Lead	0.05	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	-	-
Mercury	0.002	<0.005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	-	-
Nickel	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-
Selenium	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
Silver	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-
Thallium	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-
Zinc	5.0	<0.03	<0.03	0.11	0.09	0.09	0.03	0.03	-	-

Notes: a) USEPA Drinking Water Standards. All limits are Primary Interim Drinking Water Standards, except the standards for zinc and chloride which are Secondary Drinking Water Standards.
b) Replicate samples for Wells 3 and 12 were collected in the field.
c) - Analysis was not performed.
d) Sample jar was broken in laboratory

Table 4. Summary of Analytical Results (Organic Priority Pollutant Compounds) for Ground-Water Samples Collected During May 7-10, 1984 from Monitoring Wells, Monsanto Company, W.G. Krummrich Plant, Sauget, Illinois (concentrations are in ug/L[a]).

Parameters	Well No. 1	2	3	3-Rep[b]	4	5	6	7	8	9	10	11	12	12-Rep[b]	Laboratory Blank	Laboratory Blank	Trip Blank
Volatile Organic Compounds																	
Benzene	<1	<1	<1	-	<1	2	1	-[c]	2	449	<1	-	3,263	4,819	2	<1	-
Chlorobenzene	-	-	-	-	-	-	-	-	-	701	-	-	304	399	-	-	-
Chloroform	-	-	-	<1	<1	-	<1	-	-	2	<1	-	-	-	1	<1	<1
1,1-Dichloroethane	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	-	-	-	-	-	-	-	-	-	3	-	-	17	17	-	-	-
Methylene chloride	32	74	51	53	38	102	451	53	161	22	53	22	23	31	27	14	53
Tetrachloroethylene	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-
Toluene	1	1	1	2	2	2	2	2	2	2	2	2	17	22	2	2	2
1,2-Trans-dichloro-ethylene	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,1,1-Trichloro-ethane	-	-	3	-	-	-	7	6	4	4	-	-	-	-	5	-	-
Trichloroethylene	-	3	-	-	-	-	1	-	-	<1	-	-	-	-	2	1	-
Acid Extractable Organic Compounds																	
2-Chlorophenol	-	-	-	-	-	-	-	-	-	58	-	-	29	31	-	-	-
2,4-Dichlorophenol	-	-	-	-	-	-	-	-	-	7	-	-	-	-	-	-	-
Pentachlorophenol	-	-	-	-	-	-	-	-	-	12	-	-	-	-	-	-	-
Phenol	-	-	-	-	-	-	-	-	-	-	-	-	18	15	-	-	-
Base/Neutral Extractable Organic Compounds																	
Bis(2-ethylhexyl) phthalate	-	<1	<1	-	2	<1	5	2	3	3	4	<1	211	2	3	<1	-
Butyl benzyl phthalate	-	-	-	-	-	-	-	-	-	14	-	3	-	-	-	-	-

Table 4. (Continued)

Parameters	Well No. 1	2	3	3-Rep[b]	4	5	6	7	8	9	10	11	12	12-Rep[b]	Laboratory Blank	Laboratory Blank	Trip Blank
Base/Neutral Extractable Organic Compounds (Continued)																	
1,2-Dichlorobenzene	-	-	-	-	-	-	-	-	-	30	-	-	344	364	-	-	-
1,3-Dichloroenzene	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-
1,4-Dichlorobenzene	-	-	-	-	-	-	-	-	-	40	-	-	-	1	-	-	-
Diethyl phthalate	3	2	1	1	1	1	1	2	1	-	1	1	2	2	1	1	-
Dimethyl phthalate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Di-n-butyl phthalate	2	3	3	2	3	1	2	3	3	2	3	2	3	3	-	2	-
Naphthalene	<1	-	-	-	-	-	-	-	<1	-	-	-	4	4	-	-	-
Nitrobenzene[b]	-	-	-	-	-	-	-	-	1	<1	-	-	-	-	-	-	-
Phenanthrene	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Total	38	87	59	58	46	109	470	68	177	1,353	63	30	4,235	5,710	43	20	55
Total excluding methylene chloride:	6	13	8	5	8	7	19	15	16	1,331	10	8	4,212	5,679	16	6	2

Note: a) This data represents only those compounds which were detected. See Table 2 for the entire list of Organic Priority Pollutants that were examined for each ground-water sample.
b) Replicate sample collected in the field.
c) - Not detected

Table 5. Summary of Analytical Results for Ground-Water Samples Collected During February 6-7, 1984 from Monitoring Wells, Monsanto Company, W. G. Krummrich Plant, Sauget, Illinois (concentrations are in mg/L, except where noted).

Well No.	pH (units)	Specific Conductance (umhos/cm)	Temperature (°C)	Total Phenols	Total Organic Carbon	TOX (ug/L)	Chloride
1	8.1	950	14	0.004	24	21	50
2	7.5	2,900	14	<0.002	7	33	275
3	8.2	800	13	0.002	9	12	15
4	7.6	850	14	<0.002	12	19	45
5	7.9	650	14	0.004	16	13	10
6	7.4	1,900	15	0.003	11	31	55
7	7.3	1,400	14	0.003	10	30	35
8	6.7	1,150	14	0.003	16	57	10
9	7.1	4,000	14	0.003	25	59	495
9a)	7.1	4,000	14	0.054	24	55	480
10	7.1	2,000	15	<0.002	9	28	15
11	7.2	1,100	13	<0.002	18	33	40
12	7.8	7,000	16	0.86	29	5,200	1,055
12a)	7.8	7,000	16	0.11	30	5,100	1,050
Field Blank	7.0	110	10	<0.002	<5	19	35
Trip Blank	-b)	-	-	<0.002	<5	9	-
Laboratory Blank	-	-	-	<0.002	<5	9	-

Notes:

a) Replicate samples for Wells 9 and 12 were collected in a large common container and dispensed to each sample bottle.

b) - Analysis was not performed.

Table 6. Summary of Analytical Results (Inorganic Parameters and TOX, TOC, and Total Phenols) for Ground-Water Samples Collected During November 15-17, 1983 from Monitoring Wells, Monsanto Company, W.G. Krummrich Plant, Sauget, Illinois (concentrations are in mg/L, except where noted).

Parameter	USEPA Limits[a]	Well 1	Rep[b] Well 1	Well 2	Rep[b] Well 2	Well 3	Well 4	Well 5	Well 6
pH (units)	-	-	-	-	-	8.5	7.8	7.8	7.5
Specific Conductance (umhos/cm)	-	1,200	1,200	3,000	3,000	2,500	1,050	625	2,000
Temperature (°F)	-	53	53	52	52	54	53	52	53
Total Phenols	-	0.020	0.019	0.007	0.003	0.006	0.004	0.003	0.020
TOC	-	66/54.5[c]	22/26[c]	120/46.5[c]	40/48[c]	72	42	36	36
TOX (ug/L)	-	16	20	160	510	540	17	11	110
Cyanide	-	<0.005	-	0.005	-	<0.005	<0.005	<0.005	<0.005
Antimony	-	0.011	-[d]	0.165	-	0.097	0.014	0.009	0.012
Arsenic	0.05	0.017	-	<0.002	-	0.007	<0.002	<0.002	0.007
Beryllium	-	0.023	-	0.019	-	0.027	0.017	0.013	0.012
Cadmium	0.01	<0.01	-	0.030	-	0.020	<0.01	<0.01	0.01
Chromium	0.05	0.411	-	0.048	-	0.051	<0.04	<0.04	<0.04
Lead	0.05	<0.001	-	0.057	-	0.035	<0.001	0.001	0.004
Mercury (ug/L)	2.0	<0.2	-	0.47	-	0.35	<0.2	<0.2	<0.2
Nickel	-	0.08	-	0.18	-	0.09	<0.04	<0.04	0.05
Selenium	0.01	<0.002	-	0.006	-	<0.002	<0.002	<0.002	0.002
Silver	0.05	<0.001	-	0.006	-	0.002	<0.001	<0.001	<0.001
Thallium	-	0.002	-	0.062	-	0.047	0.003	0.004	0.004
Zinc	5.0	0.334	-	3.26	-	6.41	0.014	0.011	0.018

Notes:
a) USEPA Drinking Water Standards. All metals are Primary Interim Drinking Water Standards, except the standard for zinc which is a Secondary Drinking Water Standard.
b) Replicate samples for Wells 1 and 2 were collected in the field. Replicate results for Well 9 were determined by analyzing the same well water twice as an internal check on performance by Envirodyne Engineers, Inc.
c) The first set of results for TOC were three times higher than the replicate values, therefore, Envirodyne repeated the analysis. The corrected results are reported as the second number of each pair of values.
d) - Analysis was not performed.

Table 6. (Continued)

Parameter	USEPA Limits[a]	Well 7	Well 8	Well 9	Rep[b] Well 9	Well 10	Well 11	Well 12	Field Blank	Trip Blank
pH (units)		7.3	6.8	7.0	-	7.0	7.3	7.9	-	-
Specific Conductance (umhos)		1,150	1,200	8,500	8,500	2,100	1,100	30,000	<50	-
Temperature (°F)		53	54	51	-	52	54	53	60	-
Total Phenols		0.003	0.013	0.190	-	<0.002	0.002	0.68	<0.002	<0.002
TOC		28	84	112	130	72	36	118	2	2
TOX (ug/L)		9	150	750	-	13	22	4,700	<5	13
Cyanide		<0.005	0.021	0.016	-	<0.005	<0.005	0.013	-	-
Chloride		-	-	-	-	-	-	5,198	-	-
Antimony		0.010	0.012	0.017	0.017	0.011	0.012	0.131	-	-
Arsenic	0.05	0.002	<0.002	0.003	0.005	<0.002	<0.002	0.024	-	-
Beryllium	-	0.010	0.012	0.013	<0.01	<0.01	<0.01	<0.01	-	-
Cadmium	0.01	0.01	<0.01	0.010	<0.01	<0.01	<0.01	0.03	-	-
Chromium	0.05	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	-	-
Lead	0.05	0.001	0.005	0.005	0.005	0.004	0.002	0.015	-	-
Mercury (ug/L)	2.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	-	-
Nickel	-	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.13	-	-
Selenium	0.01	0.005	<0.002	0.004	0.003	0.003	0.003	0.034	-	-
Silver	0.05	<0.001	0.002	<0.001	<0.001	0.006	<0.001	<0.001	-	-
Thallium	-	0.002	0.003	0.007	0.006	0.004	0.003	0.023	-	-
Zinc	5.0	0.015	0.010	0.030	0.037	0.049	0.019	0.037	-	-

Notes: a) USEPA Drinking Water Standards. All metals are Primary Interim Drinking Water Standards, except the standard for zinc which is a Secondary Drinking Water Standard.

b) Replicate samples for Wells 1 and 2 were collected in the field. Replicate results for Well 9 were determined by analyzing the same well water twice as an internal check on performance by Envirodyne Engineers, Inc.

c) - Analysis was not performed.

Table 7. Summary of Analytical Results (Organic Priority Pollutant Compounds) for Ground-Water Samples Collected During November 15-17, 1983 from Monitoring Wells, Monsanto Company, W.G. Krummrich Plant, Sauget, Illinois (concentrations are in mg/L, except where noted).

Parameters	Well No. 1	2	3	4	5	6	7	8	9	10	11	12	12-Rep[d]	Laboratory Blank	Laboratory Blank
Volatile Organic Compounds															
Benzene	-[c]	-	-	-	-	<1	1	3	331	2	<1	425	433	-	-
Chlorobenzene	-	-	-	-	-	-	-	-	1,270	-	-	350	296	-	-
Chloroform	2	28	11	-	1	2	2	1	1	1	1	2	1	1	-
1,1-Dichloroethane	-	-	-	-	-	-	-	-	-	-	-	<1	<1	-	-
Ethylbenzene	-	-	-	-	-	-	-	8	-	-	-	-		-	-
Methylene chloride	18	12	12	9	10	18	11	16	10	21	16	49	64	34	26
Tetrachloroethylene	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-
Toluene	-	-	-	-	2	1	<1	-	2	<1	<1	4	4	-	-
1,2-Trans-dichloroethylene	-	-	-	-	-	-	-	-	<1	-	-	-	-	-	-
1,1,1-Trichloroethane	5	-	-	-	-	2	<1	6	3	1	<1	8	7	-	-
Trichloroethylene	6	6	<1	-	-	2	<1	-	<1	-	-	-	-	-	-
Acid Extractable Organic Compounds															
2-Chlorophenol	-	-	-	-	-	-	-	-	55	-	-	182	160	-	-
2,4-Dichlorophenol	-	-	-	-	-	-	-	-	21	-	-	-	-	-	-
Pentachlorophenol	-	-	-	-	-	-	-	-	58	-	-	147	115	-	-
Phenol	<1	<1	-	-	<1	-	-	<1	<1	-	-	40	38	-	-
Base/Neutral Extractable Organic Compounds															
Bis(2-ethylhexyl) phthalate	<1	13	1	<1	<1	<1	1	1	<1	<1	<1	<1	<1	<1	-
Butyl benzyl phthalate	-	-	<1	<1	-	-	-	-	<1	1	-	-	-	-	-
1,2-Dichlorobenzene	-	-	-	-	-	-	-	-	33	-	-	366	-	-	-
1,4-Dichlorobenzene	-	-	-	-	-	-	-	-	38	-	-	-	-	-	-

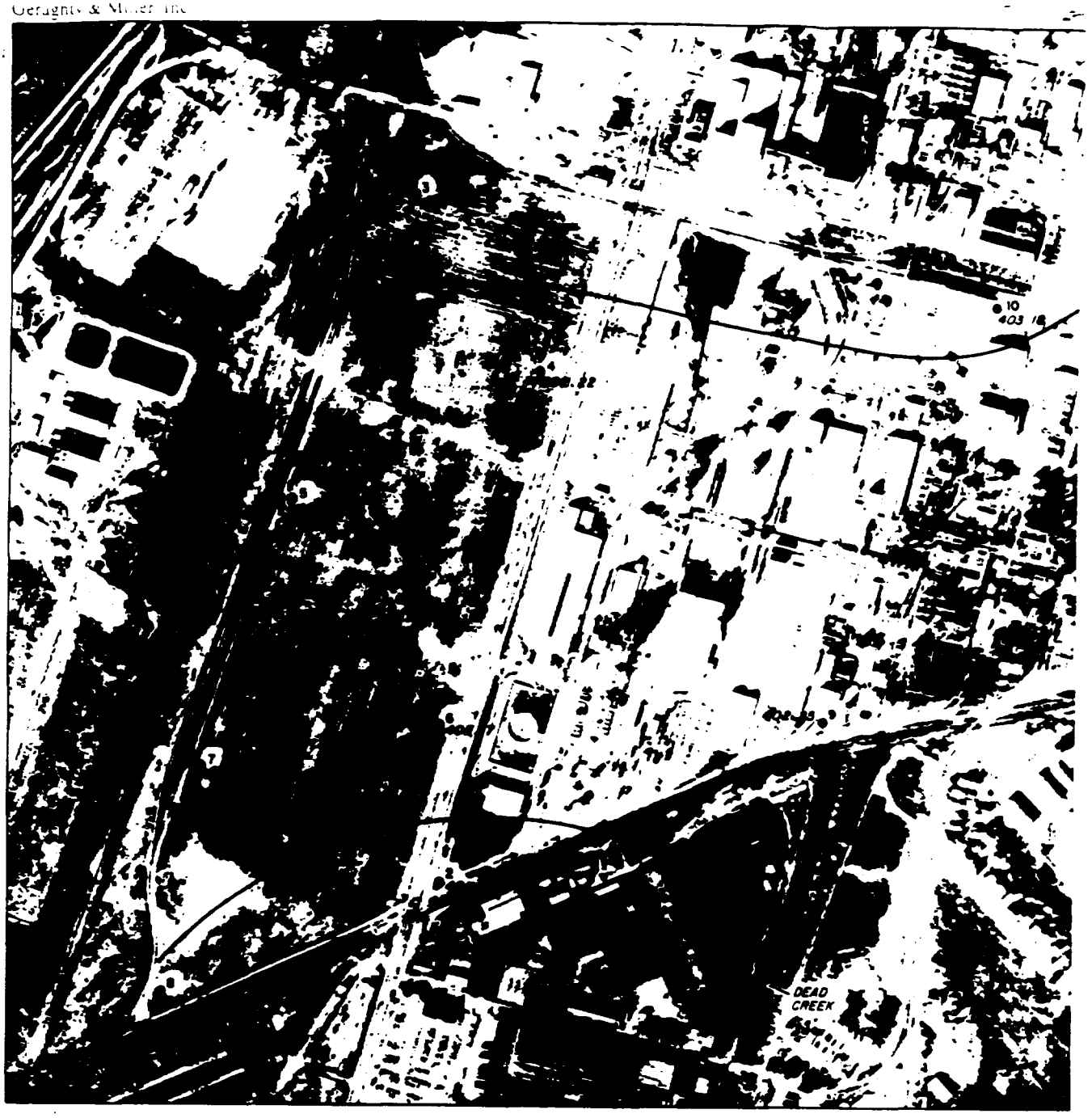
Table 7. (Continued)

Parameters	Well No. 1	2	3	4	5	6	7	8	9	10	11	12	12-Rep[d]	Laboratory Blank	Blank
Base/Neutral Extractable Organic Compounds (Cont'd)															
Diethyl phthalate	-	-	<1	<1	-	-	<1	-	-	-	-	-	-	<1	-
Dimethyl phthalate	-	-	-	-	-	<1	-	-	-	-	<1	-	-	-	-
Di-n-butyl phthalate	1	2	2	2	1	2	2	1	1	1	1	2	1	1	-
Naphthalene	-	-	-	-	-	-	-	-	-	-	-	<1	<1	-	-
Nitrobenzene	-	-	-	-	-	-	-	8	-	-	-	-		-	-
Phenanthrene[b]	-	-	-	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	-	-
Total	32	61	26	11	14	57	15	43	1,828	26	22	1,595	1,500	35	27

Note: a) This data represents only those compounds which were detected. See Table 3 for the entire list of Organic Priority Pollutants that was examined for each ground-water sample.
b) Phenanthrene coelutes with anthracene; therefore, the peak area is calculated as one compound.
c) - Not detected
d) Replicate results for Well 12 were determined by analyzing the same well water twice as an internal check on performance by Envirodyne.

Appendix B

Figures



EXPLANATION

3 — MONITORING WELL LOCATION AND DESIGNATION

403.64 — WATER-TABLE ELEVATION IN FEET ABOVE MEAN SEA LEVEL

403.0 — LINE OF EQUAL WATER-TABLE ELEVATION IN FEET ABOVE MEAN SEA LEVEL

DIRECTION OF THE HORIZONTAL COMPONENT OF GROUND-WATER

0 200 400 FT

CONFIGURATION OF THE WATER TABLE ON MAY 8, 1984

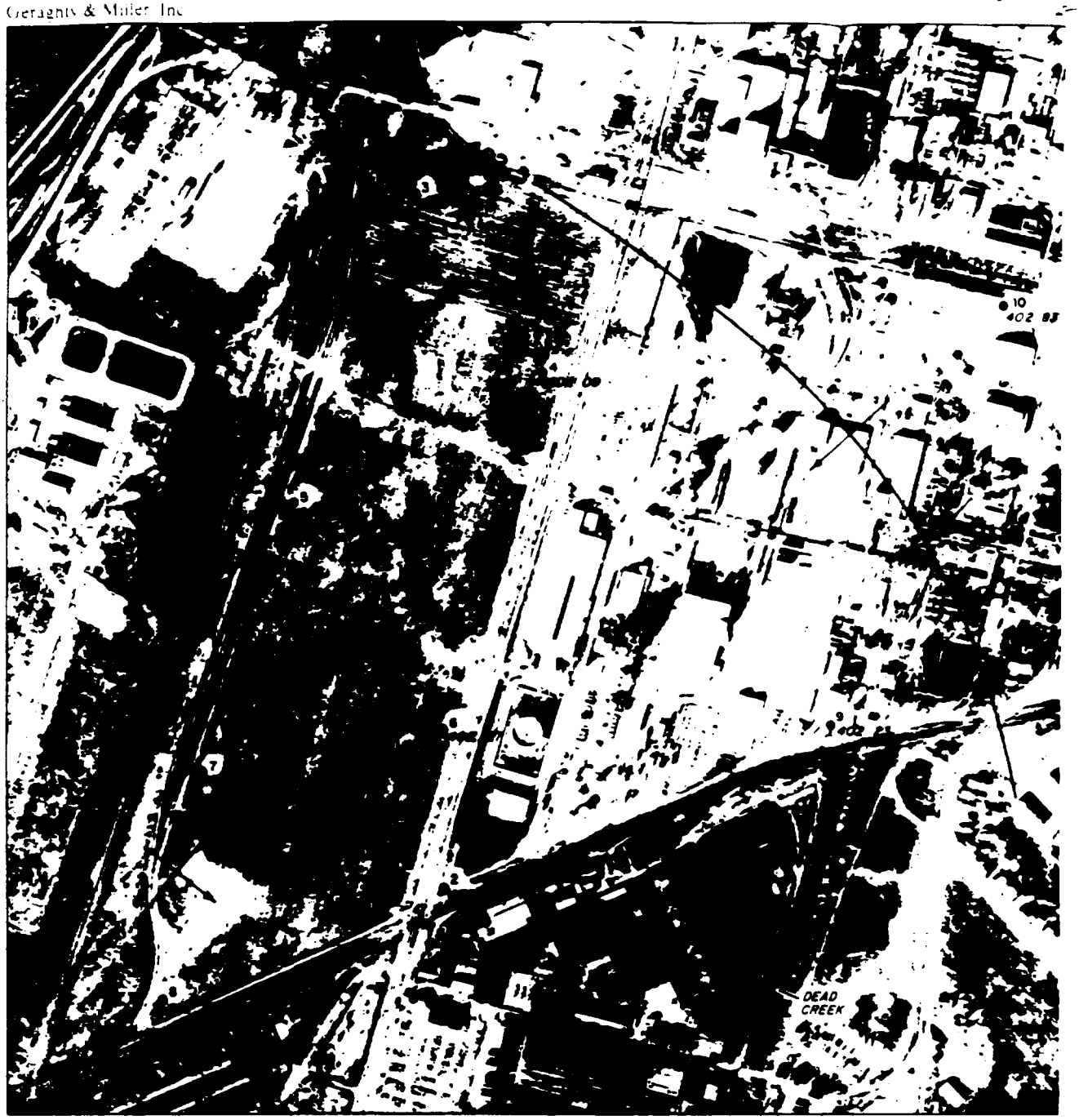
MONSANTO COMPANY
W G KRUMMRICH PLANT
Sauget, Illinois

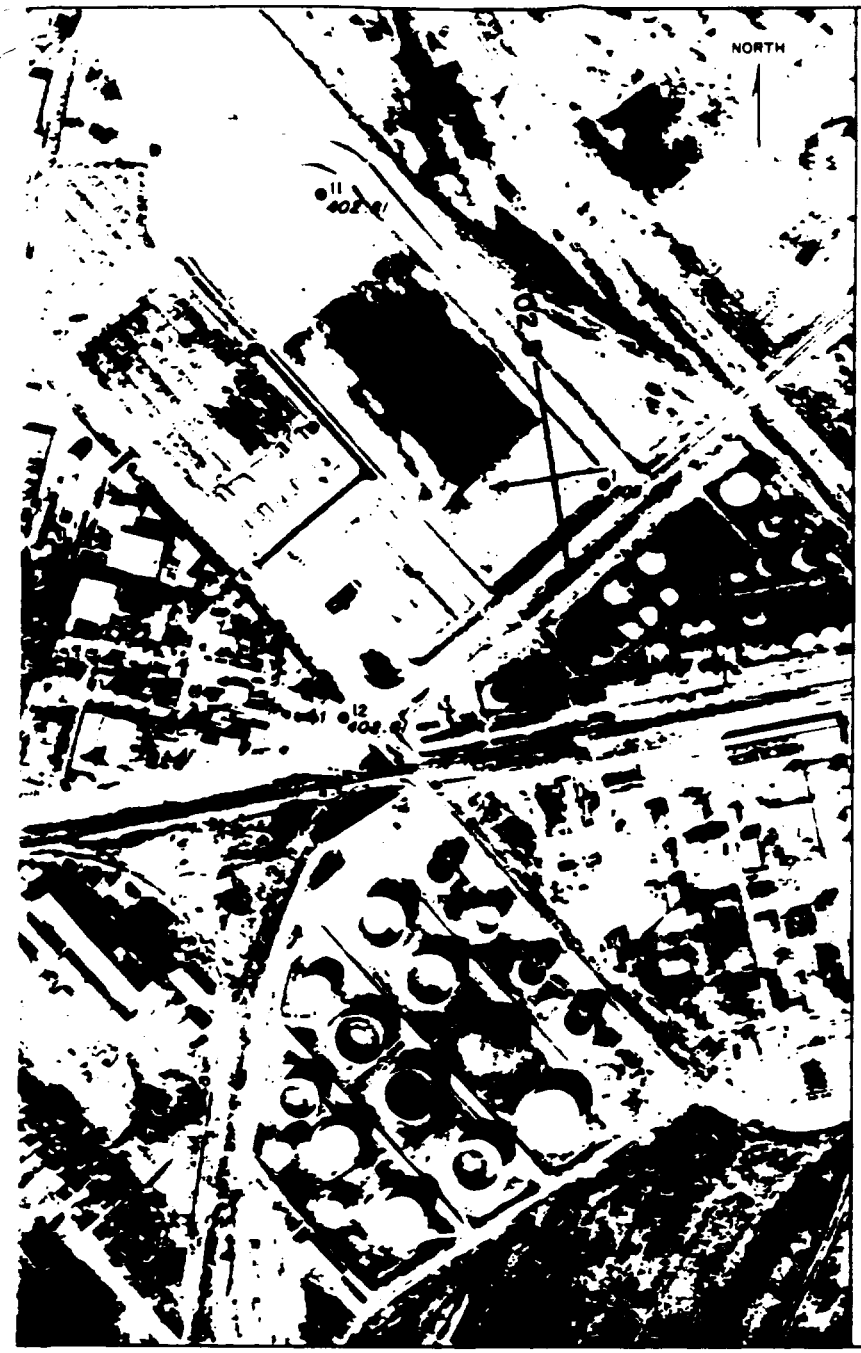
THIRD QUARTER

Figure 1

CONFIDENTIAL 92-CV-204-WDS

CER 093649





EXPLANATION

- 3 — MONITORING WELL LOCATION AND DESIGNATION
- 403.06 — WATER-TABLE ELEVATION IN FEET ABOVE MEAN SEA LEVEL
- 403.0 — LINE OF EQUAL WATER-TABLE ELEVATION IN FEET ABOVE MEAN SEA LEVEL
- DIRECTION OF THE HORIZONTAL COMPONENT OF GROUND-WATER

0 200 400 FT

CONFIGURATION OF THE WATER TABLE ON JULY 10, 1984

MONSANTO COMPANY
W.G. KRUMMRICH PLANT
Sauget, Illinois

THIRD QUARTER

Figure 3

CONFIDENTIAL 92-CV-204-WDS

CER 093653

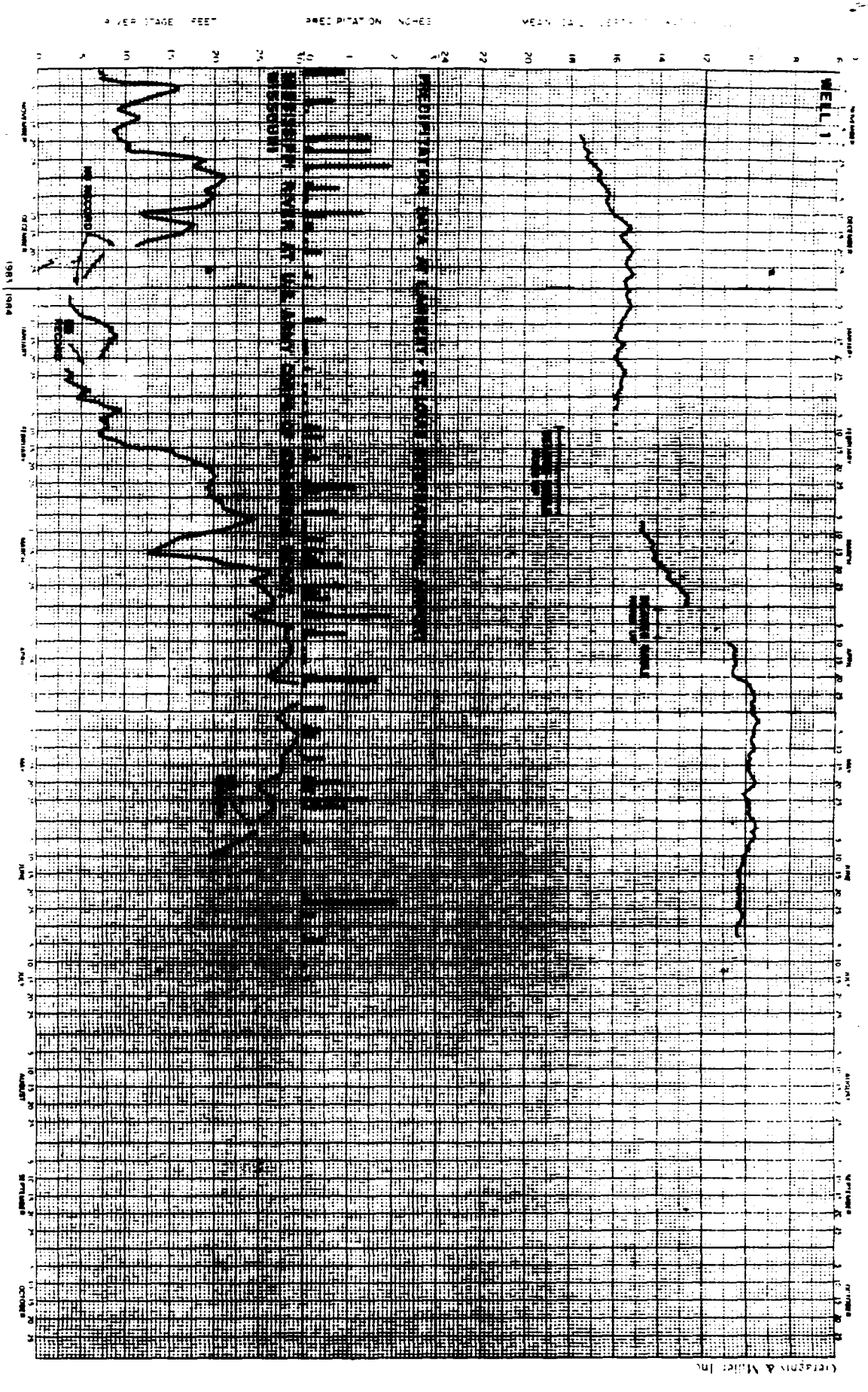


FIGURE 4a – HYDROGRAPHS FOR WELL 1 AND THE MISSISSIPPI RIVER AND PRECIPITATION DATA

MONSANTO COMPANY W.G. KRUMMRICH PLANT SAUGET, ILLINOIS

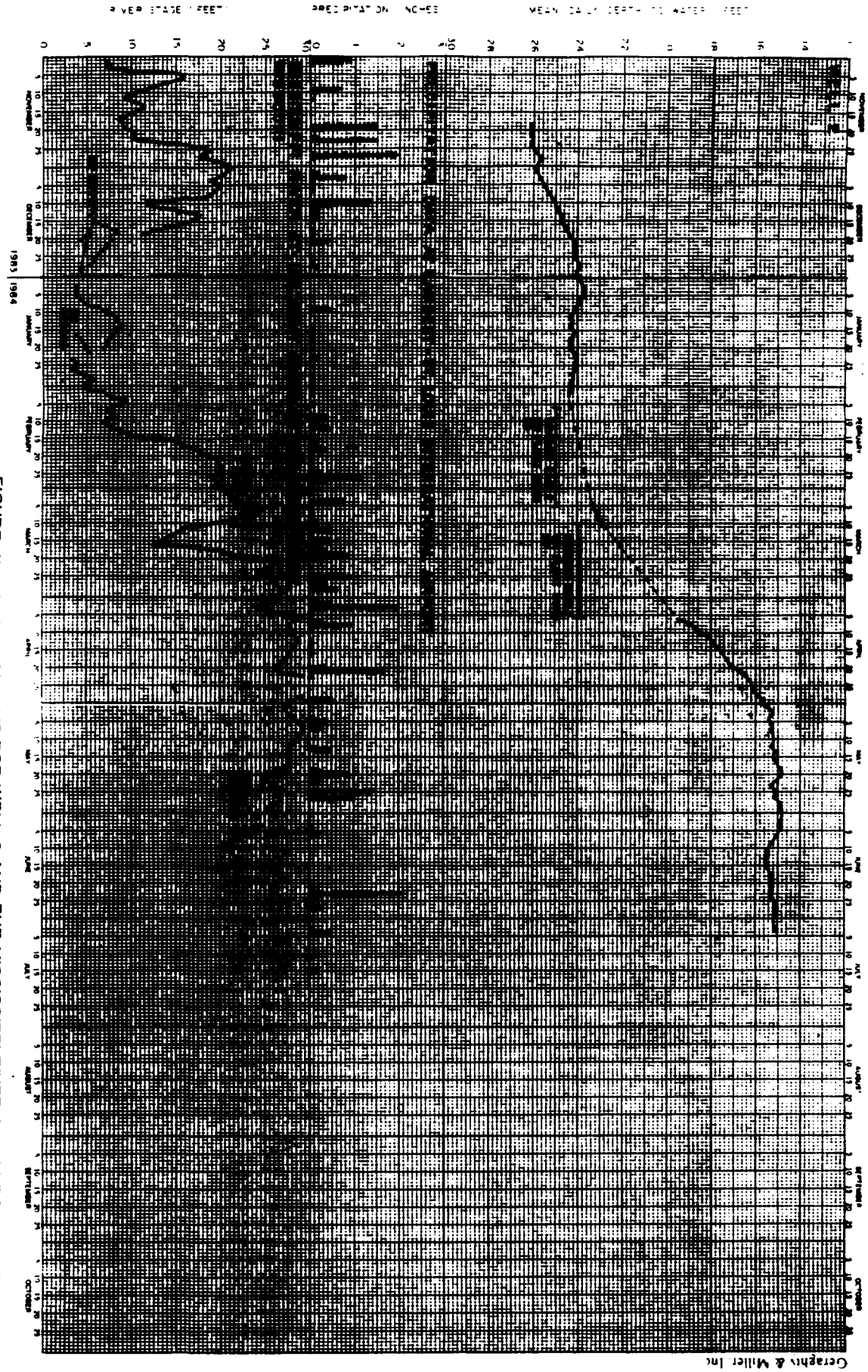


FIGURE 4b - HYDROGRAPHS FOR WELL 2 AND THE MISSISSIPPI RIVER AND PRECIPITATION DATA

[illegible] PLANT SAUGET, ILLINOIS

CONFIDENTIAL 92-CV-2[illegible]-WDS

CER 093655

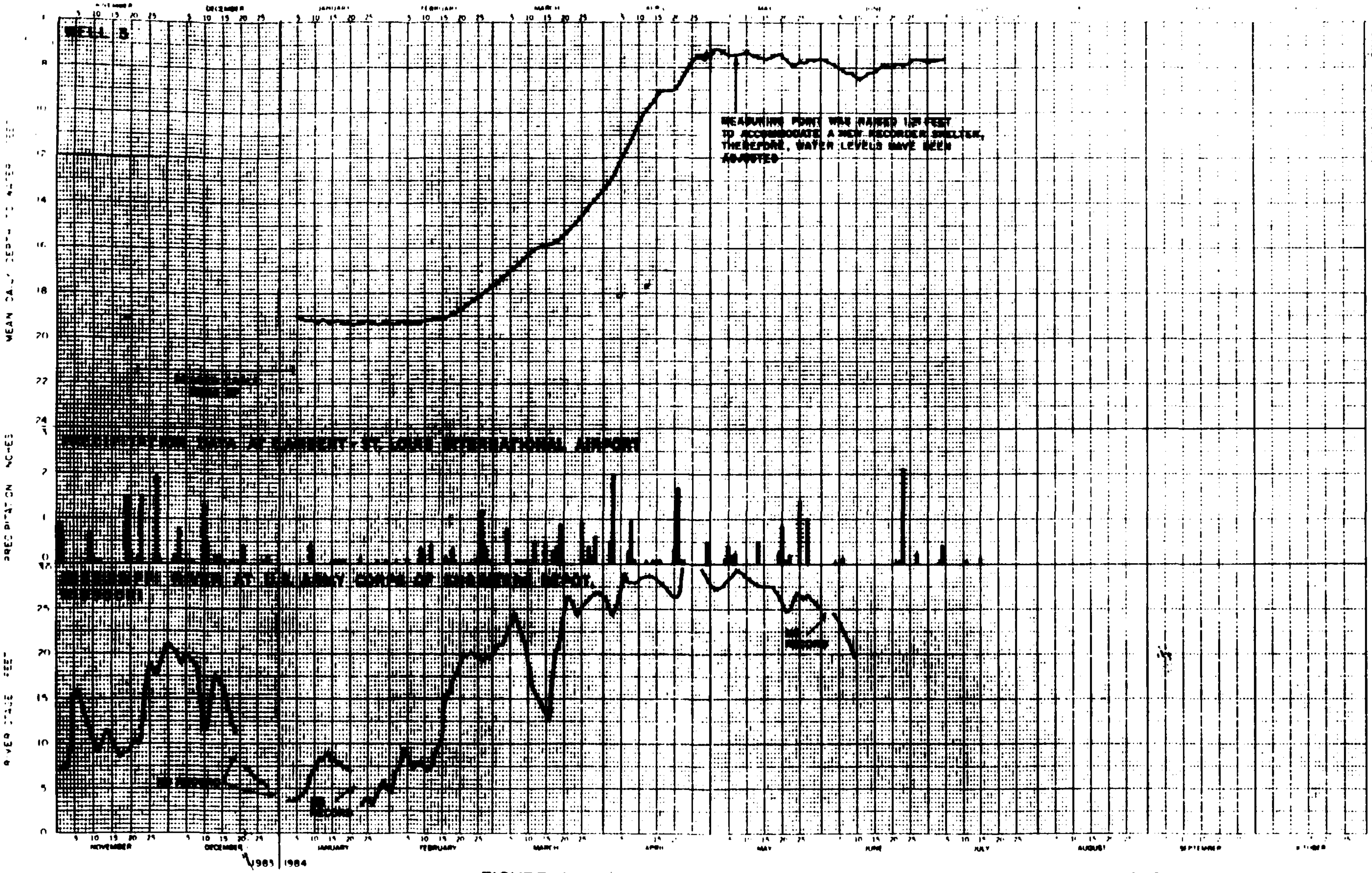


FIGURE 4c - HYDROGRAPHS FOR WELL 3 AND THE MISSISSIPPI RIVER AND PRECIPITATION DATA

MONSANTO COMPANY W.G. KRUMMRICH PLANT SAUGET, ILLINOIS

CER 093656

CONFIDENTIAL 92-CV-204-WDS

EXPLANATION

3 MONITORING WELL LOCATION AND DESIGNATION

1000 SPECIFIC CONDUCTANCE, MICROMHOS PER CM

SPECIFIC CONDUCTANCE
OF GROUND WATER

MONSANTO COMPANY
W G KRUMMRICH PLANT

THIRD QUARTER

Figure

CONFIDENTIAL 92-CV-204-W

CER 093658

3 MONITORING WELL LOCATION AND DESIGNATION

25/22 TOTAL ORGANIC CARBON (mg/l) - REPLICATE SAMPLE ANALYSIS

DISTRIBUTION OF
TOTAL ORGANIC CARBON (TOC)
IN GROUND WATER

MONSANTO COMPANY

THIRD QUARTER

Figure 6

CONFIDENTIAL 92-CV-204-W

CER 093660

EXPLANATION

MONITORING WELL LOCATION AND DESIGNATION

TOTAL HALOGENATED COMPOUNDS

REPLICATE SAMPLE ANALYSIS

DISTRIBUTION OF TOTAL ORGANIC HALOGENATED COMPOUNDS (TOX) IN GROUND WATER

MONSANTO COMPANY

THIRD QUARTER

Figure 7

EXPLANATION

3 MONITORING WELL LOCATION AND DESIGNATION

REPLICATE SAMPLE ANALYSIS

0 200 400 FT

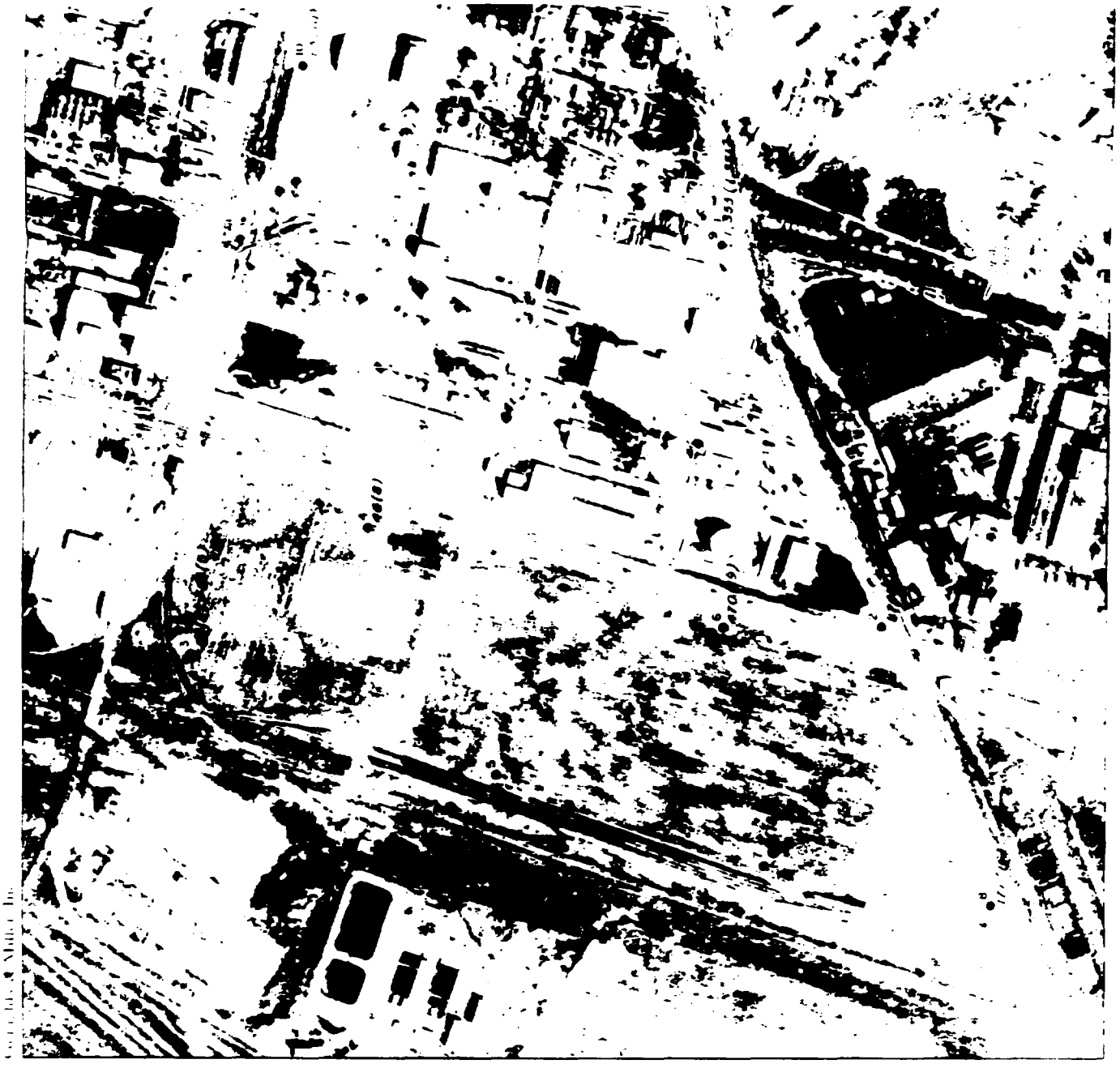
DISTRIBUTION OF TOTAL PHENOLS IN GROUND WATER

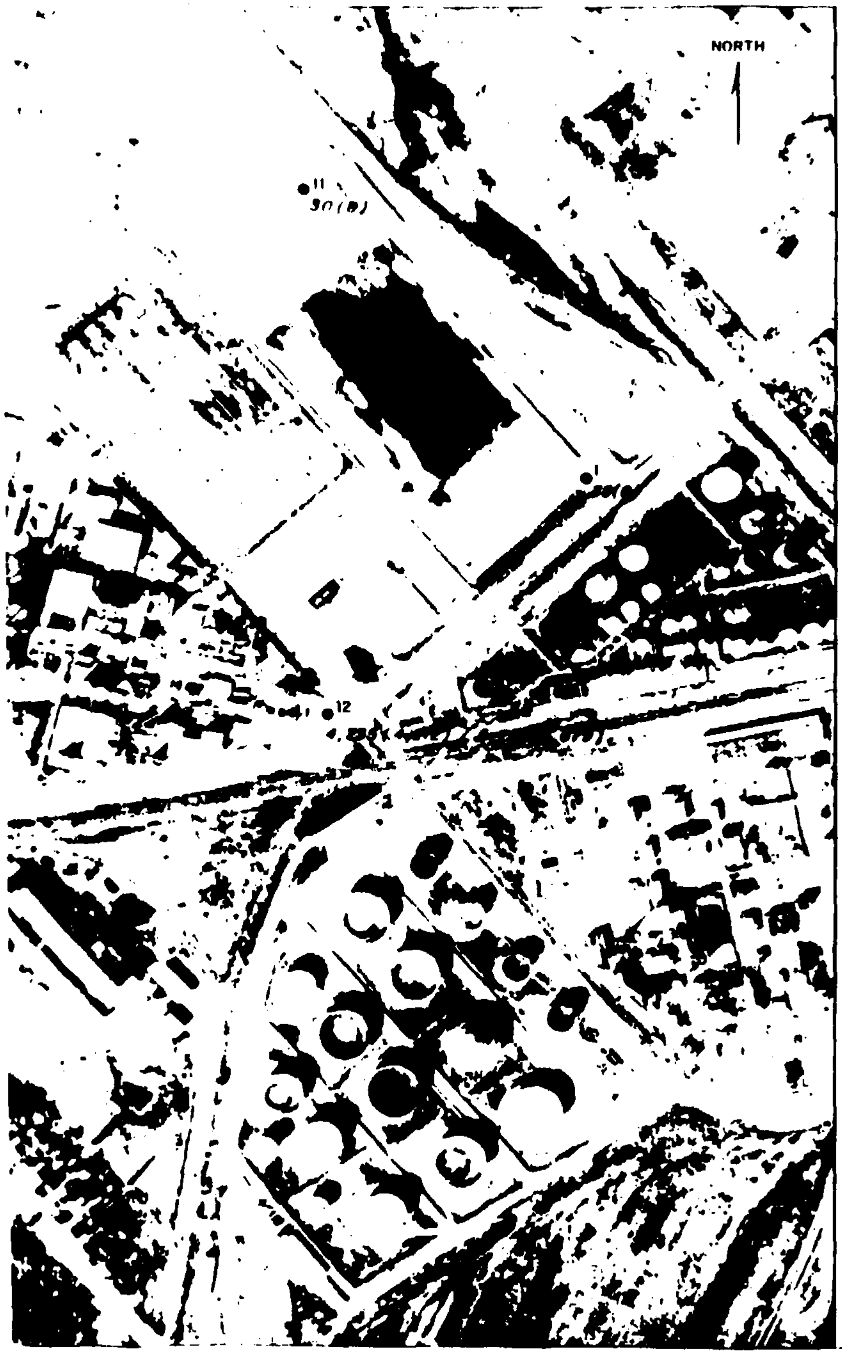
MONSANTO COMPANY

THIRD QUARTER

CONFIDENTIAL 92-CV-204-W

CER 093664





MONITORING WELL LOCATION AND DESIGNATION

0 200 400 FT

DISTRIBUTION OF TOTAL ORGANIC PRIORITY POLLUTANT COMPOUNDS IN GROUND WATER

MONSANTO COMPANY
W.G. KRUMMRICH PLANT
Sauget, Illinois

Figure 9